Chapter 5

SOLUTION DEVELOPMENT

In moving from issue identification/analysis to solution development, several water source options were considered to address the water supply issues identified. Eight water source options were initially identified to consider in the UEC Planning Area. These options either make additional water available from the same source or other sources (e.g., the Floridan aquifer), or they reduce demand (e.g., conservation). The eight options are:

- Aquifer storage and recovery
- Conservation
- Floridan aquifer
- Ocean water
- SAS wellfield expansion
- Surface water storage (includes RAFs and inter-district transfers)
- Utility interconnects
- Wastewater reuse

Development of each of these options could have regional, as well as local responsibilities.

WATER RESOURCE DEVELOPMENT AND WATER SUPPLY DEVELOPMENT

Recent amendments to Chapter 373, F.S. require that water supply plans include a list or menu of water source options for water supply development for local water users to choose from. For each source option listed, the estimated amount of water available for use, the estimated costs, potential sources of funding, and a list of water supply development projects which meet applicable funding criteria should also be provided. In addition, water supply plans must also include a listing of water resource development projects that support water supply development. For each water resource development project listed, an estimate of the amount of water to become available, timetable, funding, and who will implement, should be provided. These amendments were passed in 1997 as this plan was under development. These requirements are addressed in Chapters 5 and 6.

The statute defines water resource development and water supply development as follows:

> "Water resource development" means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and ground water data; structural and nonstructural programs to protect and manage water resources; the development of regional water resource implementation programs; the construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and ground water recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities.

and,

> "Water supply development" means the planning, design, construction, operation, and maintenance of public or private facilities for water collection, production, treatment, transmission, or distribution for sale, resale, or end use.

For the purposes of this report, the advisory committee concluded the water management district is responsible for water resource development to attain the maximum reasonable-beneficial use of water; to assure the availability of an adequate supply of water for all competing uses deemed reasonable and beneficial; and to maintain the functions of natural systems. Local users have primary responsibility for water supply development and choosing which water source options to develop to best meet their individual needs. For an option to be a water resource development project, the advisory committee suggested the following be considered:

- Opportunity to address more than one resource issue
- Address a variety of use classes (e.g., environment, public water supply)
- Protect/enhance resource availability for allocation
- Move water from water surplus areas to deficit areas
- Broad application of technology ("broad-reaching")

For an option to be a water supply development project, the advisory committee suggested the following be considered:

- Localized implementation of technology
- Delivery of resource to consumer
- "Regionalized" interconnects to consumer

OPPORTUNITIES AND ROLES

Each option was screened by the advisory committee to determine its applicability in the UEC Planning Area. In addition, a determination if the option is a water resource development project and/or water supply development project was made. The water management district will have a primary role in implementation of a water resource development project, while local users will have the primary role in implementation of a water supply development project. The results of this assessment are located in Table 9.

Table 9. Opportunities and Roles.

Water Source Option	Regional (WMD)	Local (User)
Aquifer Storage and Recovery	Primary	Primary
Conservation	Secondary	Primary
Floridan Aquifer System	Primary	Primary
Ocean Water	Primary	Primary
SAS Wellfield Expansion	Secondary	Primary
Surface Water Storage	Primary	Primary
Utility Interconnects	Secondary	Primary
Wastewater Reuse	Secondary	Primary

The advisory committee determined the local user had a primary role in implementation of all the options, while the District had a primary role in aquifer storage and recovery (ASR), the Floridan Aquifer System, ocean water, and surface water storage. The principal reason the local user has the primary role in implementation of all of the options is that one option may be more effective (quantity, cost) than the others in meeting its individual local needs. This assessment and decision needs to take place at the local level and cannot be done in the context of this regional plan.

The advisory committee reviewed the water source options to assess those that had the most potential to address the greatest number of water supply issues (Table 10).

Table 10. Potential of Water Source Options to Address UEC Water Supply Issues.

Water Source Option	UEC Water Supply Plan Issues: Surface Water Availability	Floridan Water Quality	Cumulative Impacts/ SAS Expansion Limited	Watershed Management Options-Discharges to SLE/IRL	Saltwater Intrusion Vulnerability
Aquifer Storage and Recovery	X		X	X	X
Conservation			X		X
Floridan Aquifer System	X		X		X
Ocean Water			X		X
SAS Wellfield Expansion			X		
Surface Water Storage	X	X	X	X	X
Utility Interconnects			X		X
Wastewater Reuse			X		X

WATER SOURCE OPTIONS AND STRATEGIES

From this evaluation, surface water storage, aquifer storage and recovery, and the Floridan aquifer had the greatest potential to address several of the issues. The advisory committee discussed each of the options and defined the use of the options and strategies to implement the option.

Surface Water Storage

Definition and Discussion

This option involves the capture and storage of excess surface water during rainy periods and subsequent release during drier periods for environmental and human uses. Regionally, surface water storage could be used to attenuate freshwater flows to the St. Lucie Estuary (SLE) and the Indian River Lagoon (IRL) during rainy periods and meet minimum flows during drier periods. In addition, these facilities could increase surface water availability for current and projected agricultural uses, and decrease the demand on the Floridan aquifer. This option also includes the interdistrict transfer of surface water, potentially the SJRWMD.

Locally, strategically located surface water storage (primarily storage in combination with improved storm water management systems) could recharge SAS wellfields, reduce the potential for saltwater intrusion and reduce drawdowns under wetlands. Onsite storage in agricultural areas may reduce the need for water from the regional canal system and withdrawals from the Floridan aquifer.

IRL Restoration Feasibility Study. To address the freshwater discharges to the SLE and IRL, the SFWMD, in cooperation with the U.S. Army Corps of Engineers (USACE), is conducting the Indian River Lagoon Restoration Feasibility Study (Feasibility Study) to investigate regional water resource opportunities in relation to the C&SF Project canal system in the UEC Region. As described in Chapter 2, this five-year study will develop a regional plan to address environmental restoration of areas adversely impacted by the C&SF Project system, and other water supply opportunities in the region.

The primary focus of the Feasibility Study is environmental restoration. This includes evaluating several alternatives, such as regional attenuation facilities (surface water storage areas), to meet the salinity envelope for the SLE, as well as enhancing surface water availability for water supply. The desired salinity envelope will be met through managing freshwater discharges to the SLE. Based on the analysis to date, this would equate to an inflow range of 350 cfs to 1,600 cfs. The salinity envelop and associated inflow, are being refined in the IRL Feasibility Study and development of the minimum flow and level (MFL) for the SLE. The salinity envelope concept is discussed in greater detail in the Minimum Flows and Levels section later in this chapter and the Support Document. Pursuant to Chapter 373, F.S., the District has designated the SLE as a priority water body for establishment of a MFL by 2001.

The advisory committee also recommended that any alternatives that include the transfer of excess water from the UEC Region must insure that the water needs of the UEC Region, including the estuaries be met first. In addition to identifying the volume of water that needs to be attenuated (by basin), evaluating alternatives to meet this need, and designing the preferred alternative, the advisory committee stressed the need to construct the facilities to meet the MFL for the SLE, and inflow target for the IRL. The advisory committee also stated that if the UEC Region contributes to other regions of the District, including Everglades restoration, there should be some benefit realized within the UEC Region.

A subcommitee of the advisory committee was established to review the results of the surface water budgets and other related information; and to make a recommendation of the surface water – water supply needs for the UEC Region. In addition to the results of the surface water budget analyses, the subcommittee, as well as the advisory committee, recommend the following criteria be applied in estimating future water demands during the analysis phase of the Feasibility Study to determine the implications of meeting these needs:

1. Surface water would be used to meet all western agricultural demands.
2. Demands should be based on a 1-in-10 drought condition.
3. The Floridan aquifer would be used only during drought events greater than a 1-in-10 drought condition.
4. An 85 percent irrigation efficiency should be used in determining demands.

The goal of the analysis should be to determine the amount of storage that would be needed to meet these demands in addition to environmental restoration. This should be an optimal goal; water supply demands less than this may need to be analyzed to conduct a cost/benefit analysis of providing facilities to meet this demand.

Regional Attenuation Facility Task Force. The Feasibility Study builds upon the findings of the Regional Attenuation Facility Task Force. The Martin and St. Lucie County Commissions jointly established the task force to identify potential sites for Regional Attenuation Facilities (RAF). The task force used the following basin storage volumes: C-23 Basin – 32,000 acre-feet; C-24 Basin – 36,500 acre-feet; C-44 Basin – 47,000 acre-feet; North Fork Basin – 46,500 acre-feet; South Fork Basin – 17,500 acre-feet; and C-25 Basin – 36,000 acre-feet. The task force identified 20 potential sites totaling over 65,000 acres. The results of the task force's efforts are contained in the Regional Attenuation Facility Task Force Final Report, dated April 30, 1997. (The Executive Summary of this report is in Appendix K.)

Ten Mile Creek Project. One potential regional water storage area is the Ten Mile Creek project. This $30 million project would provide storage of storm water from the Ten Mile Creek Basin, which is the largest subbasin delivering water to the North Fork of the St. Lucie Estuary. At this time, the Ten Mile Creek project is ranked eleventh on the Water Resources Development Act critical projects list and is competing with approximately 30 other south Florida projects for a share of $75 million of federal cost-share monies. A general formula for funding is a 50/50 cost split between the federal government and local sponsor (SFWMD). The environmental benefits, as well as the potential water supply benefits, are currently being quantified for this project.

Upper St. Johns River Basin Project. The feasibility of connecting to the Upper St. Johns River Basin Project via the C-25 extension as a potential alternative to store water during wet periods and provide water for environmental needs and water supply during dry periods was discussed. The committee supported further evaluation of this alternative to determine its potential in addressing freshwater flows to the Indian River Lagoon and water supply needs of the region. A request for USACE participation in this evaluation has been made. The USACE has considered the request and indicated that a thorough evaluation of the impacts to the Upper St. Johns River Basin Project from a proposed connection would be necessary. The evaluation tools and funding necessary to conduct this evaluation of the impacts to the Upper St. Johns River Basin Project is outside the current scope of the Feasibility Study. As such, the investigation would require the development of a Scope of Work and the SFWMD would have to enter into a cost sharing agreement to provide 50 percent of the study costs.

Lake Okeechobee Regulation Schedule Study. While the Feasibility Study is evaluating methods to better manage storm water generated within the planning area, the Lake Okeechobee Regulation Schedule Study (LORSS) is determining if operational changes could be made to have a more ecologically beneficial regulation schedule that simultaneously meets the C&SF Project objectives. This includes evaluating discharges made to the St. Lucie Canal (C-44). The study will include a thorough environmental impact analysis and quantification of economic issues associated with implementation of a revised schedule. The recommended regulation schedule will be put into effect on an interim basis until such time as the C&SF Project Comprehensive Review Study (C&SF Restudy) is completed and implementation begun. The LORSS is scheduled to be completed in 1999. Preliminary results of four lake regulation schedule simulations did not result in significant changes in the number and duration of discharges to the St. Lucie Canal (Neidrauer *et al.* 1997). At this time, it appears that structural changes are required to substantially affect these discharges to the St. Lucie Estuary.

Surface Water Storage Estimated Costs

Costs associated with surface water storage vary depending on site specific conditions of each reservoir. A site located near an existing waterway will increase the flexibility of design and management and reduce costs associated with water transmission infrastructure. Another factor related to cost would be the existing elevation of the site. Lower site elevations would allow for maximum storage for the facility while reducing costs associated with water transmission and construction excavation. Depth of the reservoir will have a large impact on the costs associated with construction. Deeper reservoirs result in higher levee elevations which can significantly increase construction costs.

Costs associated with two types of reservoirs are depicted in Table 11. The first is a minor facility with pumping inflow structures and levees designed to handle a maximum water dept of 4 feet. It also has internal levees and infrastructure to control internal flows and discharges. The second type shown below is a major facility with similar infrastructure as the minor facility. However, the water design depths for this facility range from 10 to 12 feet. Costs increase significantly for construction of higher levees but can be offset somewhat by the reduced land requirements.

Table 11. Surface Water Storage Costs.

Reservoir Type	Construction Cost $/Acre	Engineering/ Design Cost $/Acre	Construction Admin. $/Acre	Land $/Acre	Operations & Maint. $/Acre
Minor Reservoir	2,842	402	318	4,500	118
Major Reservoir	7,980	904	451	4,500	105

Source: SFWMD

Costs for the minor reservoir are based on actual construction bid estimates received and awarded for similar projects currently being built in the Everglades Agricultural Area (EAA). Costs of these four Stormwater Treatment Areas (STAs) were averaged to develop the $/Acre costs. Land costs have been changed to generally reflect land values in the Upper East Coast Planning Area. Costs for the major reservoir were developed based on the average cost estimates from the proposed Ten Mile Creek project and from the Regional Attenuation Facility Task Force Final Report, April 30, 1997 estimates for major Water Preserve Areas.

One example of a regional multi-purpose surface water storage project is the Upper St. Johns River Basin Project. This project includes over 100 miles of levees, six large capacity spillways, and 16 smaller water control structures, culverts and weirs. The project area totals 150,000 acres and is designed to accommodate half of the drainage basin of the Upper St. Johns River headwaters region. This project contains four Marsh Conservation Areas (MCAs) and 16,000 acres of Water Management Areas (WMAs). The MCAs are similar to the large water conservation areas in the Everglades. MCAs detain floodwater and also act as shallow reservoir systems on occasion. The WMAs are deep water reservoirs and are operated to provide for long-term water supply and temporary flood storage of agricultural discharges. Estimated project costs (in 1994 dollars) are $177.7 million of which $87.3 million is land costs.

Quantity of Water Potentially Available from Surface Water Storage

Freshwater discharges from the C-23, C-24, and C-25 (1964-1995) and C-44 (1952-1995) canals averaged 304 billion gallons per year or 833 million gallons per day (MGD). These discharges are influenced primarily by rainfall and vary significantly over the period of record. Rainfall over this period averaged approximately 51 inches. In addition, discharges from the C-44 canal are influenced by regulatory discharges from Lake Okeechobee. These discharges may be less today based on changes in the Lake regulation schedule. Theoretically, a significant amount of the 833 MGD could be stored and made available for water supply, if sufficient volumes of storage were constructed. In addition to the urban and agricultural water supply needs, the needs of the environment (estuarine systems) also have to be accounted for. The volume of water that could be withdrawn by any specific user must be determined through the District's consumptive use permitting program.

Surface Water Storage Recommendations

The advisory committee suggested the District consider the following water resource development recommendations regarding surface water storage:

1) Complete the Feasibility Study by 2000, including the following considerations:
   - In addition to environmental restoration, the Feasibility Study should consider enhancing surface water availability in basins where the UEC Water Supply Plan indicated there is a surface water availability deficit (Refer to Figure 7).
   - The Feasibility Study should utilize the Regional Attenuation Facility Task Force Report.
   - The Feasibility Study should examine the C-25/Fort Pierce system to the same degree as the SLE.
   - The UEC Water Supply Plan Advisory Committee and staff should contribute to

the Feasibility Study.
- The District will evaluate the potential combination of surface water storage and aquifer storage and recovery.
- Coordinate the Feasibility Study with the SJRWMD to maximize both distribution efforts.
- Implement the Feasibility Study recommendations.

The Feasibility Study is consistent with this recommendation.

2) The District will support the design and construction of the Ten Mile Creek project, and other appropriate RAFs.
3) The District will develop and adopt a minimum flow and level (which

   includes maximum discharges) for the SLE, based on the salinity envelope concept by 2001.
4) Evaluate increasing storage and conveyance in the C-canals through maintenance dredging of canals and sediment control.

The advisory committee made the following water supply development suggestions regarding surface water storage:

1) Water supply benefits (recharge) should be considered when designing storm water storage/treatment areas. Consideration of funding should be given to projects incorporating surface water storage meeting pre-development runoff.
2) Chapter 298 Districts should be encouraged to incorporate water supply in their Water Control Plans to the extent practicable.
3) Prioritize storm water projects that have beneficial ground water recharge.
4) Look at developments that lower the ground water table.
5) Participate in and support the Restudy Joint Coordination Committee(Martin and St. Lucie counties), which is charged with being involved in the Feasibility Study, and making reports to both counties and interested agencies.
6) New or widening roadway projects should include retention/detention and ground water recharge/water supply design elements, without compromising the structural integrity of the road.

Aquifer Storage and Recovery

Definition and Discussion

Aquifer storage and recovery (ASR) is the underground storage of injected water into an acceptable aquifer (typically the Floridan aquifer in southeast Florida) during times when water is available, and the subsequent recovery of this water when it is needed. In other words, the aquifer acts as an underground reservoir for the injected water, reducing water loss to evaporation. Current regulations require injected water to meet drinking water standards when the receiving aquifer is classified as an underground source of drinking water (USDW) aquifer, unless an aquifer exemption is obtained.

Raw Water ASR. The advisory committee discussed two different applications of this technology in the UEC Planning Area, ASR in combination with surface water storage, and utility ASR. The first involves injection of surface water that has been captured and stored in a RAF to supplement storage or enhance water supply. The evaluation should include the proposed capacity, number of wells, recovery efficiency, seasonality of demands, and operating costs. The RAF would capture excess surface water and provide sufficient volumes of water for the ASR injection cycle. Water levels in the RAF and regional canals would then be supplemented with water from the ASR system during drier periods. However, this water would have to meet drinking water standards prior to injection or an aquifer exemption from the U.S. Environmental Protection Agency (EPA) would have to be obtained. Obtaining an aquifer exemption is a rigorous process and very few have been approved. Currently, there are no operating, untreated surface water ASR projects in Florida. However, the SFWMD was previously granted a limited aquifer exemption to inject untreated surface water for the ASR Demonstration Project for Lake Okeechobee.

ASR Demonstration Project for Lake Okeechobee. The original purpose of the ASR Demonstration Project for Lake Okeechobee was to determine the role of ASR technology in diverting nutrients from Lake Okeechobee, with diversion of water from the Taylor Creek/Nubbin Slough basin. Other goals that were developed as the project progressed were to: determine the physical ability of storing large volumes of surface water; the effects of storage on the water quality, including bacterial survival; and recovery efficiency. The results of the study indicate large volumes of surface water could be stored through ASR wells, changes in water quality could occur (especially phosphorus), fecal coliforms could be eliminated by storage in the Floridan aquifer, and high permeability zones reduce the recovery efficiency in ASR wells. The project concluded in 1989 and the well has not been used since. The advisory committee discussed the potential of reactivating the well for research purposes.

Treated Water ASR. Utility ASR would involve using potable water as the injection water. Since potable water meets the drinking water standards, this type of ASR application is more easily permitted. There are many examples in Florida, including south Florida, of utilities using treated water ASR.

The committee recommended that pumps on ASR wells be evaluated on a case-by-case basis. Major consideration for approval should be given to potential impacts on existing legal users, and to a lesser extent, potential water quality changes. The advisory committee also recommended that rules be developed to address the use of the Floridan aquifer for ASR and ASR efficiency in the UEC Planning Area, in order to avoid conflicts with the use of the Floridan aquifer as a water source. One suggestion was to identify different horizons (depths) or areas for each activity.

Other Injection Opportunities. Another concept discussed by the committee was injecting excess surface water into the Floridan aquifer for aquifer recharge, and into the SAS (among other sources) to serve as a saltwater intrusion barrier. This potentially could serve to regionally recharge the Floridan aquifer, and result in lowering the chloride content of the water. Water would not be recovered from the injection wells, but through existing wells on users property. Excess surface water and other sources, such as reclaimed water, could be injected into the SAS to create a saltwater intrusion barrier in high vulnerability areas. Each of these concepts would have to be shown to be both resource and cost effective and comply with appropriate regulations.

Aquifer Storage and Recovery Estimated Costs

Estimated costs for an ASR system largely depend on whether the system requires pumping equipment. As shown in Table 12, one system uses pressurized water from a utility; whereas the second ASR system uses unpressurized treated water, thus requiring pumping equipment as part of the system cost. (Please refer to the Support Document for cost assumptions). The latter system with its associated pumping costs is more indicative of an ASR system in combination with surface water storage. There may also be additional costs for screening and filtering untreated surface water to remove floating and suspended matter.

Table 12. Aquifer Storage and Recovery System Costs.*

System	Well Drilling Cost (Per Well)	Equipment Cost (Per Well)	Engineering Cost (Per Well)	O&M Cost (per 1000 gal)	Energy Cost (per 1000 gal)
Treated Water at System Pressure	$200,000	$30,000	$360,000	$.004	$.06
Treated Water Requiring Pumping	$200,000	$100,000	$400,000	$.006	$.06

*Costs based on a 900-foot, 16-inch well, with two monitoring wells using treated water.
Source: PBS&J, 1991, Water Supply Cost Estimates.

Quantity of Water Potentially Available from ASR

The volume of water that could be made available through ASR wells depends upon several local factors, such as well yield, water availability, variability in water supply, and variability in demand. Without additional information, it is not possible to accurately estimate the water that could be available through ASR in the UEC Region. Typical storage volumes for individual wells range from 10 to 500 million gallons (31 to 1,535 acre-feet). (Pyne, 1995). Where appropriate, multiple ASR wells could be operated as a wellfield, with the capacity determined from the recharge and/or recovery periods. There are potentially many different applications of ASR; however, all store sufficient volumes (adequate volumes to meet the desired need) during times when water is available and recover it from the same well(s) when needed. The storage time is usually seasonal, but can also be diurnal, long-term or for emergencies. The volume of water that could be made available by any specific user must be determined through the District's consumptive use permitting program.

Aquifer Storage and Recovery Recommendations

The advisory committee suggested the District consider the following water resource development recommendations regarding aquifer storage and recovery:

1) The District will evaluate the potential of co-locating aquifer storage and recovery and surface water storage to supplement storage or enhance water supply, if required and

cost effective. The Feasibility Study must first conclude that RAFs are the preferred alternative to address freshwater discharges to the SLE and IRL before this co-location evaluation is conducted.

2) The District will evaluate existing water quality data in District databases for canal water in anticipation of surface water ASR.
3) The District will be available for preapplication meetings to local users evaluating the feasibility of ASR.
4) The District will evaluate the potential of reactivating the District ASR Demonstration Project for Lake Okeechobee well to collect data on surface water ASR. Also, the District will look at the potential of a public/private partnership.
5) The District will continue working with EPA and FDEP to explore rule changes to the federal and state underground injection control program to allow for (and encourage) injection of untreated surface water and ground water with ASR.
6) The District will clarify known ASR benefits of injecting untreated surface water and ground water and identify areas for further study.
7) The District will develop rules to address the use of the Floridan for ASR, as well as water use, and potential conflicts.
8) The District will evaluate injection of surface water, and other sources of water such as reclaimed water, to increase the freshwater head along the coast to decrease the potential of saltwater intrusion, where regional benefits are identified.
9) Where appropriate, the District will evaluate the feasibility of injecting excess surface water to recharge the Floridan aquifer in the UEC Region.

The advisory committee made the following water supply development suggestions regarding aquifer storage and recovery:

1) Explore treated and untreated water ASR, among other options, to supplement existing water supply sources in order to meet future demands.

2) Continue working with EPA and FDEP to explore rule changes to the federal and state underground injection control program to allow for (and encourage) injection of untreated surface water and ground water with ASR.

Floridan Aquifer

Definition and Discussion

The Floridan aquifer is used extensively by citrus growers in the UEC Planning Area, primarily as a supplemental irrigation source when surface water availability is limited and as a primary source in areas where no surface water is available. Water from the Floridan is generally blended with surface water to reduce potential problems associated with water quality. Water quality is critical in maintaining the sustainability of this source. Excess salinity in citrus can result in decreased production/yield, reduction in root growth, and can be fatal to specific root stocks (Syvertsen *et al.* 1989). The Floridan is nonpotable throughout the planning area and requires desalination or blending prior to potable use. The Floridan aquifer is currently being used by Fort

Pierce Utilities Authority for blending with SAS water and Martin County Utilities and a number of smaller private coastal facilities as a primary source. However, most of the utilities in the planning area plan to use the Floridan in the future. The Floridan has potential for supplying the portion of the projected demands that cannot be met by the SAS.

Floridan Aquifer Subcommittee. The advisory committee established the Floridan Aquifer Subcommittee to evaluate options and develop strategies for managing the Floridan Aquifer System (FAS). The subcommittee consisted of representatives from various interested and affected parties in the planning area such as Floridan users from the agricultural and utility industries, local 298 water control districts, the Florida Department of Environmental Protection (FDEP), consultants, Institute of Food and Agricultural Sciences (IFAS), the Natural Resources Conservation Service (NRCS) and St. Lucie Soil and Water Conservation District (SLSWCD).

The subcommittee reviewed existing available information including current resource allocation criteria, water quality data, water use data, water level data, regional ground water modeling results, resource protection criteria, and water use activities outside the planning area in Indian River County. Water use information (metered) is very limited; a majority of the usage data is estimated. Long-term water quality and water level information is also sparse and, the relationships between water use, water quality, and water level are uncertain. A comprehensive monitoring network does not exist at this time to collect data to provide insight into these relationships.

Pumps on Floridan Aquifer Wells. Based on the available information, the subcommittee concluded there is no basis (or need) to justify any change to the current resource allocation criteria at this time. The subcommittee recommended continuation of the prohibition of pumps on Floridan aquifer wells, whose purpose is to increase withdrawals over that which occurs through artesian pressure. It was also recommended that consideration be given to short-term allowances of pump usage during freezes and extreme water shortages. This conclusion is based on the limited information/data, understanding of the previously mentioned relationships, and no user need (including public water supply) to modify the criteria. Of 18 irrigation wells and 5 utilities in the UEC Region and vicinity with historic water quality records, only 6 showed a long-term increase in salinity.

Some members of the subcommittee felt that the use of the Floridan aquifer is self-regulating because of water quality concerns, and the existing resource allocation guidelines have not posed a problem to date. It was the general consensus of the subcommittee that if upconing of higher salinity water into the production zone of a well occurs, the water quality could be degraded to a point where it is probably not useful as an irrigation source. Caution should be practiced so this does not occur.

Floridan Aquifer Monitoring Program. The subcommittee recommended establishing a comprehensive monitoring program to collect the necessary information to develop the water use, water quality, and water level relationships. The existing well monitoring programs should be coordinated and serve as the foundation of the comprehensive program. They should be expanded where appropriate. This information will be used in future Floridan Aquifer System discussions and evaluations, and will be useful during future updates of the UEC Water Supply Plan and resource allocation criteria.

The subcommittee recommended continued coordination between the St. Johns River Water Management District (SJRWMD) and the South Florida Water Management District.

Related Issues. Because of long-term water quality concerns and the sustainability of the Floridan aquifer for agricultural purposes, the subcommittee strongly recommended continued investigation and development of water source options, consistent with other regional studies. Specifically, increasing surface water availability through regional attenuation facilities and aquifer storage and recovery to

conserve the Floridan aquifer in the agricultural areas. Other efforts to decrease Floridan aquifer demands, such as water conservation, should also be encouraged.

To conserve water in the Floridan aquifer and protect the water quality in the surficial aquifer, the subcommittee also recommended reestablishment of a volunteer well abandonment program similar to the one previously administered by the District. Criteria should be developed to prioritize wells to be abandoned. The benefits versus the program cost should be quantified, and it was suggested the program be implemented through the NRCS or SLSWCD. The District's program was a 12-year cooperative effort that ended in 1991. This was a voluntary program and the purpose was to identify abandoned artesian wells, geophysically log them, and plug or rehabilitate the well as necessary to prevent the deterioration of the SAS aquifer through upward leakage or discharge at land surface. In the UEC Planning Area, 336 wells were plugged or rehabilitated, including all known free-flowing wells. A similar volunteer Floridan aquifer well abandonment program was initiated in late 1997 through the NRCS using cost-share funds from USDA's Environmental Quality Incentive Program (EQIP) and the SFWMD. This recent program is anticipated to be active at least through 1998.

The subcommittee reviewed information regarding impacts of Floridan water use on the water quality in the Surficial Aquifer System (SAS), and did not recommend further consideration. Data indicates elevated total dissolved solids concentrations in the SAS in western and central St. Lucie County. However, this is generally limited to less than 50 feet below land surface. There are some residential self-supply wells in these areas, but they are generally greater than 50 feet deep.

Floridan Aquifer Estimated Costs

The costs related to wellfield expansion for the Floridan Aquifer System are provided in Table 13. For potable water use, there are additional costs for desalination treatment, such as reverse osmosis (Table 14) and concentrate disposal (Table 15). Site-specific costs associated with reverse osmosis (RO) can vary significantly as a result of source water quality, concentrate disposal requirements, land costs, and use of existing water treatment plant infrastructure. As a general rule, RO costs are 10 to 50 percent higher than lime softening. For brackish water with total dissolved solids up to 10,000 mg/L, electrodialysis and electrodialysis reversal are generally effective, but cost about 5 to 10 percent higher than RO treatment (Boyle Engineering, 1989).

Table 13. Well Costs for the Floridan Aquifer System.

Floridan Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	O&M Cost (per 1000 gal)	Energy Cost (per 1000 gal)
Costs	$92,000	$52,000	$14,000	$.003	$.032

*Costs based on a 16-inch diameter well and a maximum Floridan well depth of 900 feet.
Source: PBS&J, 1991, Water Supply Cost Estimates.

Table 14. Reverse Osmosis Treatment Costs.*

Facility Size (MGD)	Capital Costs (per gal/day capacity	Engineering Cost (per gal/day capacity)	Land Requirements (Acres)	O&M Cost (per 1000 gal)	Energy Cost (per 1000 gal)
3	$1.40	$.21	.40	$.46	$.23
5	$1.27	$.19	.40	$.43	$.23
10	$1.17	$.18	.50	$.41	$.23
15	$1.14	$.17	.63	$.40	$.23
20	$1.16	$.16	.78	$.30	$.23

*Costs based on 2,000 mg/L TDS, 400 PSI.
Source: PBS&J, 1991, Water Supply Cost Estimates.

Table 15. Concentrate Disposal Costs.

Deep Well Disposal Facility (MGD)	Capital Cost (per gal/day capacity)	Engineering Cost (per gal/day capacity)	Land Requirements (Acres)	O&M Cost (per 1000 gal)
3	$.58	$.087	0.5	$.032
5	$.44	$.066	0.5	$.024
10	$.40	$.060	1.0	$.022
15	$.37	$.056	2.0	$.020
20	$.30	$.045	3.0	$.016

Source: PBS&J, 1991, Water Supply Cost Estimates.

Quantity of Water Potentially Available from the Floridan Aquifer

The analysis indicated the Floridan aquifer has the potential of supplying, at a minimum, sufficient water to meet all public water supply demands (64 MGD) through the planning horizon while meeting the supplemental water needs (125 MGD) of agricultural users during a 1-in-10 drought event. This assumes withdrawals will be obtained from existing or proposed wells in the agricultural areas, and from wells in proximity of existing Surficial Aquifer System wells for public water supply. The Floridan aquifer model was used to evaluate the impact of increased Floridan aquifer use. Considering the worst case scenario, all future public water supply (PWS) demands were transferred to the FAS. This is in addition to the users already projected to be using the Floridan aquifer. This is an extreme case in that if the utilities choose to use the Floridan aquifer to meet future demands, the Floridan would most likely only supplement, not replace, their existing SAS withdrawals. As a result, actual Floridan withdrawals could be significantly less than evaluated. The results of this analysis indicate there would be no resource protection criterion exceedances if all PWS met their entire demand with Floridan aquifer water. The volume of water that could be withdrawn by any specific user must be determined through the District's consumptive use permitting program.

The Floridan aquifer has been used regularly by agricultural users, and to a lesser extent, public water supply users in the UEC Region and Indian River County. Out of the limited number of Floridan wells that have historic water quality records, some have showed increases in salinity, but the majority have not. The analysis did not incorporate a water quality component nor does sufficient data exist to conduct such an analysis. However, the analysis indicated water levels are not projected to decline below land surface, and the experience in the UEC Region suggests this should not result in significant changes in water quality. As stated previously, a monitoring program is recommended to collect information on water use, water quality, and water levels.

Floridan Aquifer Recommendations

The advisory committee suggested the District consider the following water resource development recommendations regarding the Floridan aquifer:

1) The District will develop and implement a comprehensive regional Floridan aquifer monitoring network to collect the necessary information to develop relationships between water use, water quality, and water levels.
2) The District will develop options for a volunteer or incentive based Floridan well abandonment program.
3) The District will make available the Floridan aquifer model and provide technical assistance to users exploring the potential of using the Floridan aquifer.
4) The District will work with FDEP and EPA to explore alternative desalination concentrate disposal options.
5) The District will continue prohibiting pumps on Floridan wells, except for short-term usage during extreme water shortages and freezes.
6) The District will eliminate the existing 1.5 inch allocation restriction in northwest St.

Lucie County, since the modeling did not indicate any potential problems.

7) The District will evaluate Floridan aquifer recharge areas (in central Florida and outside the planning area) and identify activities, if any, that could have a resulting negative effect on the Floridan aquifer in the UEC Planning Area.

The advisory committee made the following water supply development suggestions regarding the Floridan aquifer:

1) Evaluate desalination concentrate disposal options.
2) Local users should coordinate their plans with adjoining utilities, as well as the UEC Water Supply Plan.

Surficial Aquifer System Wellfield Expansion

Definition and Discussion

Expansion of an existing wellfield is usually the first option investigated by users, when additional raw water is required. Wellfield expansion is limited by the rate of recharge and water movement in the aquifer, environmental impacts, proximity to contamination sources, saltwater intrusion, and other existing legal users in the area.

The committee discussed identifying recharge areas for the Surficial Aquifer System. The idea of identifying recharge areas for an aquifer is more relevant for confined aquifer systems, such as the Floridan aquifer, than unconfined aquifers. Recharge to confined aquifers is limited to areas where the confining materials between the aquifer and the source of recharge (i.e., rainfall) are thin or missing. This makes identifying prime recharge areas a straightforward, though not necessarily simple process. In an unconfined system, such as the Surficial Aquifer System in the UEC Planning Area, direct recharge to the aquifer can and does occur everywhere.

Recharge to the surficial aquifer is limited only by the availability of excess rainfall and storage space within the aquifer. The best recharge areas will have loose sandy soils, allowing rapid infiltration, and deep water tables, providing storage space for the water. Old beach ridges, for example, make excellent recharge areas. Because they are high and dry, however, these areas are also the preferred locations for development. Where development is carried out without consideration to preserving aquifer recharge, large increases in impervious areas can lead to drastic reductions in local aquifer recharge.

Wetlands also can provide recharge to ground water. Wetlands, particularly when they are topographically high, provide long-term surface water storage which contributes slow steady recharge to the surrounding aquifer. This is particularly true where ground water withdrawals induce strong gradients in the water table.

"The Bluebelt Act" (Section 193.441, F.S.) allows county governments the flexibility to implement voluntary tax assessment programs that protect the state's highwater recharge areas. To qualify for the program, the lands must be within significant recharge areas, and must be vacant residential, commercial, industrial, or institutional lands and non-agricultural. The land owner must enter into a contract with the county to agree to maintain the recharge characteristics of the land for 10 years. The advisory committee suggested the coastal ridge may qualify for this program, but would have to be reviewed with respect to the Act.

Surficial Aquifer Estimated Costs

The costs related to wellfield expansion for the Surficial Aquifer System are provided in Table16. There are additional costs for water treatment. Many of the treatment facilities in the planning area use lime softening for surficial aquifer water. Lime softening's cost advantages are in operating and maintenance expenses (Table17), where costs are typically 20 percent less than for comparable membrane technologies. However, due to increased water quality standards, several utilities are using membrane softening technology (Table 18). One significant advantage of the membrane softening technology is its effectiveness at removing organics that function as disinfection byproduct (such as trihalomethanes) precursors.

Table 16. Well Costs for the Surficial Aquifer System.

Surficial Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	O&M Cost (per 1000 gal)	Energy Cost (per 1000 gal)
Costs	$36,000	$49,000	$13,000	$.003	$.020

*Costs based on a 16-inch diameter well and a maximum Surficial well depth of 200 feet.
Source: PBS&J, 1991, Water Supply Cost Estimates.

Table 17. Lime Softening Treatment Costs.

Facility Size (MGD)	Capital Cost (per gal/day capacity)	Engineering Cost (per gal/day capacity)	Land Requirements (Acres)	O&M Cost (per 1000 gal)	Energy Cost (per 1000 gal)
3	$1.30	$.20	1.5	$.48	$.018
5	$1.25	$.19	2.5	$.45	$.018
10	$1.22	$.18	4.0	$.40	$.017
15	$1.00	$.15	6.0	$.33	$.016
20	$.90	$.13	8.0	$.30	$.016

Source: PBS&J, 1991, Water Supply Cost Estimates.

Table 18. Membrane Softening Costs.

Facility Size (MGD)	Capital Costs (per gal/day capacity	Engineering Cost (per gal/day capacity)	Land Requirements (Acres)	O&M Cost (per 1000 gal)	Energy Cost (per 1000 gal)
3	$1.33	$.20	0.40	$.44	$.159
5	$1.21	$.18	0.40	$.42	$.159
10	$1.12	$.17	0.50	$.40	$.159
15	$1.10	$.17	0.63	$.38	$.159
20	$1.06	$.16	0.78	$.37	$.159

Source: PBS&J, 1991, Water Supply Cost Estimates.

Quantity of Water Potentially Available from SAS Wellfield Expansion

The analysis indicated that expansion of SAS withdrawals for public water supply, residential self supplied, commercial and industrial self supplied, and recreational self supplied beyond existing demands (66 MGD) is limited, especially along the coast. This assumes withdrawals will be obtained from existing wells, and where information was available, from proposed wells. The analysis indicated that expansion of SAS, primarily along the coast is limited. However, there may be limited expansion potential on a project-by-project basis. The volume of water that could be withdrawn by any specific user must be determined through the District's c consumptive use permitting program. The advisory committee supports development of alternative water sources, which reduce the reliance on the SAS.

Surficial Aquifer System Recommendations

The advisory committee made no recommendations for water resource development regarding SAS wellfield expansion.

The advisory committee made the following water supply development suggestions regarding SAS wellfield expansion:

1) The potential of using the SAS for new and expanded uses should be evaluated on a project-by-project basis.
2) Encourage development of alternative water sources that reduce the reliance on the SAS.

Conservation

Definition and Discussion

This option incorporates water conservation measures that address demand reduction, including practices that achieve long-term permanent reductions in water use. The other water source options in this chapter make additional water available through using new sources or storage. However, elements of conservation are incorporated in these options as well as throughout this document.

In 1992, the District amended its water use permitting rules to incorporate specific mandatory water conservation requirements for each use type. These include implementation of the mandatory water conservation measures for public water suppliers (irrigation hours ordinance, Xeriscape landscape ordinance, ultra-low volume fixture ordinance, rain sensor device ordinance, water conservation-based rate structure, leak detection and repair program, public education program, reclaimed water feasibility), commercial/industrial users (water use audit, employee water conservation awareness program, implementation of cost-effective conservation measures), landscape and golf course users (Xeriscape landscaping, rain sensor devices, irrigation hour limitations) and agricultural users (micro-irrigation systems for new citrus and container nursery projects), as well as several other retrofit measures as described in the UEC Water Supply Plan Support Document.

There are also several supplemental water conservation measures that local users could implement if they deem any of the measures to be cost effective. Measures for urban users include indoor and outdoor retrofits and landscape audit and retrofit; public water supply utilities include filter backwash recycling and distribution pressure control; and agricultural users include irrigation audits and improved scheduling, and retrofitting with a micro-irrigation system.

Several of the mandatory conservation measures have not been implemented by utilities and/or local governments in the UEC Planning Area (Table19). Four of the mandatory water conservation measures require adoption of an ordinance by local government. Generally, because of the autonomy of local governments in the planning area, each ordinance has to be adopted by each unit of local government for the measure to be fully implemented. Positive responses in the table reflect the adoption of the appropriate ordinance by the applicable local government.

Table 19. Public Water Supply Conservation Implementation Status.

Public Water Supply Utility	Irrigation Hours Ordinance	Xeriscape Ordinance	ULV Fixtures Ordinance	Rain Sensor Ordinance	Water Conserv Rate Structure	Leak Detect & Repair Program		Public Educ Program
						% Lost*	Status	
Martin County								
Hobe Sound Water Co.	Yes	No	Yes	Yes	Yes	13.3	No	Yes
Hydratech	Yes	Yes	Yes	Yes	Yes	4.4	No	Yes
Indiantown	Yes	Yes	Yes	Yes	Yes	3.5	No	Yes
Martin County-Martin Downs	Yes	Yes	Yes	Yes	Yes	18.4	Yes	Yes
Martin County-North	Yes	Yes	Yes	Yes	Yes	13.3	Yes	Yes
Martin County-Port Salerno	Yes	Yes	Yes	Yes	Yes	10.2	Yes	Yes
Martin County-Tropical Farms	Yes	Yes	Yes	Yes	Yes	n/a	Yes	Yes
Stuart	Yes	Yes	Yes	No	Yes	13.5	Yes	Yes
St. Lucie County								
Ft. Pierce	No	No	No	No	Yes	10.0	Yes	Yes
Holiday Pines	No	Yes	No	Yes	No	3.9	No	No
Reserve	No	Yes	No	Yes	No	9.0	No	No
St. Lucie West	No	Yes	Yes	Yes	No	5.0	Yes	Yes
Port St. Lucie	No	Yes	Yes	Yes	No	9.0	No	Yes

Source: July 1997 phone interviews with local planners and utility staff.
*District standard for leak detection requirement is 10% lost or unaccounted for water (water used for pipe flushing, fire fighting, leaks, incorrect metering, and illegal connections).

The committee discussed encouraging nonpotable uses of water to use alternative water source options, especially those who are currently using potable water. The committee also discussed prioritizing encouragement of water conservation in specific geographic areas, such as water resource caution areas.

Conservation Estimated Costs

Cost and water savings for several indoor and outdoor urban retrofit water conservation measures are provided in Tables 20 and 21. In addition, the cost and water savings for irrigation system conversion for agricultural are discussed. This information in this section should not be interpreted as a benefit-cost analysis of these conservation measures, since no discounting is applied to the streams of cost and benefits.

Table 20. Representative Water-Use and Cost Analysis for Retrofit Indoor Water Conservation Measures.

	Toilet	Showerhead
Cost/unit ($)	$200	$20
Flushes/day/person	5	--
Gallons saved/flush	1.9	--
Minutes/day/person	--	10
Gallons saved/minute	--	2
Persons/unit	2.5	2.5
Life (years)	40	10
Savings/year/unit (gallons)	8,670	9,125
Savings/unit over life (gallons)	346,800	91,250
Cost/1000 gallons saved	$0.58	$0.22
Savings/cost	1.73	4.56

Table 21. Representative Water-Use and Cost Analysis for Retrofit Outdoor Water Conservation Measures.

	Rain Switch	Mobile Irrigation Lab
Cost/unit or visit ($)	$68	$50*
Acres/unit	0.11	0.11
Water savings (inches/year)	70	70
Water savings (gallons/year)	209,070	209,070
Life (years)	10 years	7 years
Water savings/life (gallons)	2,090,700	1,463,493
Cost/1,000 gallons saved ($)	$0.033	$0.034
Savings per 1,000 gallons/cost	30.75	29.27

*Represents additional cost of site visit (currently compensated by NRCS and the District).

For the urban water conservation methods, the analysis indicated the savings are greater than the costs. The savings per unit of cost associated with the outdoor conservation measures are generally greater than those for indoor conservation measures, primarily because of the larger volumes of water involved per unit affected by the outdoor conservation measures. Water savings associated with implementation of retrofit programs can be significant. For example, if 10,000 showerheads were retrofitted in an area, this could result in a water savings of 182 MGY (0.50 MGD). Likewise, if 10,000 irrigation systems were retrofitted with rain switches, this could result in a water savings of over 2 BGY (5.73 MGD).

Conversion of existing flood-irrigated citrus to micro-irrigation is another potential source of water savings (Table 22). It is estimated by IFAS that the initial cost to install a micro-irrigation system on citrus is $1,000 per acre and the system would have estimated annual maintenance costs of $25 per year (IFAS, 1993).

Table 22. Irrigation Costs and Water Use Savings Associated with Conversion From Seepage Irrigation to Low Volume.

Initial cost ($/acre)	$1,000
Operating cost ($/acre)	$25
Water savings (inches/year)	8.519
Water savings (gallons per year)	230,805
Life (years)	20
Cost over life ($)	$1,500
Water savings over life	4,616,100
Cost/1,000 gallons saved ($)	$0.33

Source: IFAS and SFWMD

The table summarizes the cost and potential water savings from one acre of conversion. The water savings from converting 25,000 acres of citrus from flood irrigation with a 50 percent efficiency to micro-irrigation with an 85 percent efficiency could result in a water savings of approximately 6 BGY (15.8 MGD). The analysis illustrates that given the large volumes of water used for irrigation by agriculture, water conservation savings (which can be achieved at a reasonable cost) will often be extremely cost effective compared to the costs of developing additional water supplies.

In addition to the water savings associated with conversion of flood-irrigated citrus to micro-irrigation, IFAS also has indicated that prescriptive applications of water and fertilizer can be made throughout the crop-growing season with micro-irrigation. As a result, micro-irrigation systems have been demonstrated to increase crop yields and decrease nutrient losses due to leaching. However, micro-irrigation systems generally have greater maintenance requirements than flood irrigation systems.

Quantity of Water Potentially Available from Conservation

A 10 percent reduction (4 MGD) in projected public water supply and residential self supplied water use is estimated with implementation of the mandatory conservation measures through the planning horizon. There are also retrofit (incorporation of current water conservation measures into existing projects) opportunities in both agricultural and urban areas. Retrofitting the approximately 40,000 remaining acres of citrus that currently use flood irrigation to micro-irrigation could result in a reduction in water use of up to 25 MGD (actual savings may be less due to cooperative use of water within 298 Districts) in water demands. Approximately 100,000 acres have been retrofitted to micro-irrigation. In urban areas, the following water savings could occur per 10,000 units installed: toilet, 0.24 MGD; showerhead, 0.50 MGD; and rain switches, 5.73 MGD. It is also estimated an urban mobile irrigation lab visiting 200 homes could reduce outdoor water usage by 0.12 MGD. These potential water savings are based on average rainfall conditions; greater water savings should be realized during drought conditions.

Many of the urban retrofit measures need to be evaluated at the local level (water supply development). For example, utilities that have high outdoor water use may want to implement an incentive program to install rain sensor devices on existing irrigation systems. Utility per capita water use rates can be used to indicate where outdoor water use with potable water is occurring. The advisory committee recommended urban retrofit water conservation is one of several water source options that should be evaluated by the local utility/government to meet existing and projected demands. A mandatory retrofit program was not recommended at this time.

The advisory committee recommended an urban mobile irrigation laboratory in the planning area might be effective in reducing water use in Martin and St. Lucie counties. Funding to start-up an urban mobile irrigation laboratory program in Martin County in 1998 has been provided. The laboratory will evaluate current outdoor water use practices and identify ways to use water more efficiently. It would also educate residents through homeowner meetings on how to use water more efficiently. One mobile irrigation laboratory currently serves the agricultural areas in Martin and St. Lucie counties. Funding for this is provided by the NRCS in support of the IRL National Estuaries Program (NEP).

Conservation Recommendations

The advisory committee suggested the District consider the following water resource development recommendations regarding conservation:

1) The District will develop fiscal incentives for entities implementing non-mandated conservation measures, such as the alternative water supply cost-share program.
2) The District will provide funding for Martin County and St. Lucie County Urban Mobile Irrigation Laboratory Programs, and possibly another Agricultural Mobile Irrigation Laboratory for the UEC Region if the need arises.
3) The District will promote water conservation for all users of water through use of higher efficiency irrigation systems and other water conservation measures.
4) The District will develop a cooperative approach, including financial incentives, with the NRCS to promote conversion of flood irrigation to micro-irrigation.

The advisory committee made the following water supply development suggestions regarding conservation:

1) Utilities and local governments should implement all public water supply mandatory conservation measures.
2) Seek funding for urban mobile irrigation laboratories in Martin and St. Lucie counties.
3) Implement higher efficiency irrigation systems and other conservation measures where effective.
4) Encourage the use of alternative water sources for nonpotable uses, versus using potable water.

Wastewater Reuse

Definition and Discussion

Reuse is the deliberate application of reclaimed water (treated wastewater that is reused) for a beneficial purpose. Potential uses of reclaimed water include landscape and agricultural irrigation, ground water recharge, industrial uses and environmental enhancement. In 1993, the 12 UEC Regional wastewater facilities treated 13.05 MGD of wastewater, of which 3.07 MGD was reused. In 1996, these facilities treated 13.32 MGD, of which 3.53 MGD was reused. Reuse included irrigation of golf courses and ground water recharge via rapid exfiltration basins and primarily occurred in urban Martin County and southern St. Lucie County.

Utility specific reuse applications can be found in the UEC Water Supply Plan Support Document and Appendices.

The results of the modeling indicate that current reuse in the UEC Planning Area, primarily irrigation of golf courses, has contributed to reduced potential resource impacts. Besides irrigation, reclaimed water could also be used to recharge wellfields, minimize drawdowns under wetlands, and reduce the potential of salt water intrusion. The advisory committee discussed encouraging alternative reclaimed water distribution systems other than piping such as using surface water systems as a conveyance system, as well as reuse projects that recharge wellfields and hydrate wetlands.

The committee also discussed ground water recharge that is occurring in the planning area via septic tank drainfields. In 1993 septic tank studies conducted by the Martin and St. Lucie County public health units (Kearney, 1993; Moses and Anderson, 1993), it was estimated that there are approximately 55,000 septic tanks in Martin and St. Lucie Counties (Martin–22,000; St. Lucie-33,000). The public health units estimate these systems process about 8 million gallons per day of wastewater. The effluent from these systems is disposed of via drainfields, resulting in ground water recharge. The studies also indicate that a majority of these systems are located within a quarter of a mile of the Indian River Lagoon (IRL) or its tributaries. Many of these systems have been identified as potential threats to the water quality of the IRL by these studies. In several of these areas, centralized wastewater collection is now being provided.

Wastewater Reuse Estimated Costs

The costs associated with implementation of a wastewater reuse program vary depending on the type of reuse system (i.e., ground water recharge, public access irrigation, etc.), the size of the reclamation facility, the facility equipment needed, the extent of the reclaimed water transmission system, and the regulatory requirements. Cost savings include negating the need for or reducing the use of alternative disposal systems, negating the need for an alternate water supply by the end user, and a reduction in fertilization costs for the end user. These costs and savings are discussed further in the Support Document and Appendices.

Quantity of Water Potentially Available from Wastewater Reuse

Regional wastewater utilities in the UEC Planning Area have projected wastewater flows to increase to approximately 43 MGD through the planning horizon. However, based on minimal increases in wastewater flows from 1993 to 1996, it is doubtful this projection will be realized within the planning horizon. In 1996, about 3.5 MGD (26 percent) of the 13 MGD processed by these facilities was reused. Assuming the projections of the utilities are realized, approximately 40 MGD of additional reclaimed water could be made available for reuse through the planning horizon.

Wastewater Reuse Recommendations

The advisory committee suggested the District consider the following water resource development recommendations regarding wastewater reuse:

1) The District will develop regulatory (including wet weather disposal) and fiscal incentives for reuse.
2) The District will encourage reclaimed water system interconnects to increase reuse in potential problem areas.
3) The District will adopt rules implementing the requirements of Section 373.250, F.S. related to wastewater reuse and back-up sources.
4) The District will provide assistance for reclaimed water projects that involve ground water recharge and indirect potable reuse, and will assume the lead role for such projects that are of regional significance.
5) The District will discuss with FDEP, and participate in related rulemaking, standards for reclaimed water quality for ground water recharge and indirect potable reuse projects.

The advisory committee made the following water supply development suggestions regarding wastewater reuse:

1) Increase use of reclaimed water in areas where adequate wastewater streams are available.
2) Maximize benefits of water resource impacts when developing a reuse program.
3) Identify areas of highest priority for funding under the District's Alternative Water Supply Funding Program.

Utility Interconnects

Definition and Discussion

This option involves the bulk purchase of treated water from neighboring utilities in lieu of expanding an existing withdrawal and/or treatment facility. Also, interconnection of treated and/or raw water distribution systems between utilities can provide a measure of backup water service in the event of disruption of a water source, treatment facility, or distribution system. Interconnections could be with utilities outside the planning area or the District. The advisory committee also suggested that interconnects between reclaimed water systems be evaluated to transfer reclaimed water from surplus areas to deficit areas.

Most of the utilities in the planning area have interconnects with adjoining utilities for emergency backup water service. Utilities that do not have interconnects with another utility are: Indiantown, Martin County Martin Downs, and Holiday Pines.

Utilities in the planning area that have interconnected with other utilities for the bulk transfer of water include St. Lucie County (serving North Hutchinson Island) from Fort Pierce Utilities Authority and the regional interconnection of Martin County's North, Port Salerno, and Tropical Farms Water Systems. Also, St. Lucie County has contracted with Indian River County Utilities for water to serve northern St. Lucie County, if needed.

Martin County has interconnected the reclaimed water distribution systems from their Tropical Farms and Port Salerno (Dixie Park) wastewater facilities.

Quantity of Water Potentially Available from Utility Interconnects

The quantity of water that could be made available from utility interconnects needs to be evaluated on a project-by-project basis. It will decrease projected withdrawals of one utility and increase withdrawals for the other. The water available for transfer depends on the sources used by the supplying utility as well as the capacity of their facilities.

Utility Interconnects Recommendations

The advisory committee suggested the District consider the following water resource development recommendations regarding utility interconnects:

1) The District will encourage potable water interconnections between utilities for emergency purposes, and evaluation of interconnections for water supply purposes, where appropriate.

The advisory committee made the following water supply development suggestions regarding utility interconnects:

1) Evaluate the potential of interconnections with adjoining utilities for emergency purposes and water supply where appropriate.
2) Evaluate the potential to interconnect reclaimed water systems to transfer reclaimed water from surplus areas to deficit areas.

Ocean Water

Definition and Discussion

This option involves using ocean water as a raw water source. The ocean appears to be an unlimited source of water from a quantity perspective; however, removal of the salts is required prior to use for potable or irrigation uses. To accomplish this, a desalination treatment technology would have to be used, such as distillation, reverse osmosis, or electrodialysis reversal (EDR).

Ocean Water Estimated Costs

The cost of desalination of ocean water is estimated to cost four to eight times the cost of reverse osmosis of the Floridan aquifer. In addition, reverse osmosis and EDR facilities treating ocean water would be expected to have an efficiency of 25 percent, resulting in increased concentrate/reject water disposal needs compared to desalination of the Floridan.

Quantity of Water Potentially Available from Ocean Water

The volume of water available from the ocean appears to be unlimited.

Ocean Water Recommendations

The committee concluded that ocean water is a potential source of water, but at this time, is not a source of water that needs to be considered based on the projected water demands, other water sources that are available, and the cost of treating this source.

Related Strategies

The advisory committee also recommended the District consider the following to implement the UEC Water Supply Plan. Most of these items recommend incorporation of the modeling assumptions used in development of this plan into the consumptive use permitting (CUP) program.

Level of Drought. The District will incorporate a uniform level of drought to determine the supplemental needs of all users in the UEC Planning Area in consumptive use permitting process. The statistical 1-in-10 dry rainfall event for the seven rainfall stations used in this plan should be used in this determination.

Resource Protection. The District will incorporate the resource protection criteria used in this plan, as may be modified/refined during the rulemaking process, into the consumptive use permitting program. The criteria used in this plan are:

(a) Wetlands. Ground water level drawdowns induced by pumping withdrawals in areas that are classified as a wetland should not exceed 1 foot at the edge of the wetland for more than 1 month during a 12-month dry rainfall event that occurs as frequently as once every 10 years.

The ground water level drawdown resulting from withdrawal of the recommended maximum daily allocation for 90 days with no recharge from rainfall (90 day-no recharge) is currently utilized in the District's permitting program. The permitting guideline is that less than one foot of drawdown at the edge of the wetland will not result in adverse impacts to the wetland. In addition to this guideline, there are other approaches that may be utilized by the applicant to provide reasonable assurance that the proposed withdrawals will not cause adverse impacts. Comparisons of the 90 day-no recharge and 1-in-10 year drought event modeling scenarios by District staff indicate that the two approaches produce similar results. The advisory committee recommends the District continue the wetland drawdown study it initiated in 1995.

The committee discussed the expense of developing alternative water source options to avoid harm to wetlands versus protecting small isolated wetlands. In some cases, it was concluded that it may be acceptable to impact a wetland (exceed resource protection criteria) and mitigate for the harm, versus developing an alternative water source option. Under the current consumptive use permitting program, mitigation for impacts to wetlands is not allowed. However, under the current Environmental Resource Permitting (ERP) program (surface water management system construction and dredge and fill activities), impacts to these same wetlands may be permitted if the impacts are determined to be unavoidable. The applicant is required to provide compensation for the loss of wetland functions, through mitigation. The advisory committee supports developing a similar wetland mitigation program to the ERP Program for water use permitting.

(b) Floridan Aquifer. Ground water level drawdowns induced by water use withdrawals should not cause water levels in the Floridan Aquifer to fall below land surface any time during a 12-month dry rainfall event that occurs as frequently as once every 10 years. This will be achieved by continuation of the current permitting criteria prohibiting pumps on flowing Floridan aquifer wells, except for short-term usage during extreme water shortages and freezes, and aquifer storage and recovery projects (ASR). Pumps on ASR wells shall be approved on a case-by-case basis.

Cumulative Analysis. The District will include a cumulative analysis as part of the consumptive use permitting analysis that contains flexibility to deal with local conditions and new technologies to accurately assess if the proposed use is permittable.

Water Shortage Triggers. Where necessary, the District will develop and adopt water shortage triggers to avoid causing significant harm to the resource, in conjunction with the implementation of the District's Water Shortage Plan (Chapter 40E-21, F.A.C.).

The purposes of the Water Shortage Plan are to protect the water resources of the District from harm; to assure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social and health related impacts; to provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage, and to promote greater security for water use permittees.

The plan's rules apply to all water users, including those exempt from permitting pursuant to Rule 40E-2.051. However, these rules shall not apply to users whose source of water is limited solely to reclaimed water or seawater. Thus, for each regulated source and type of use, it is the policy of the District to restrict water users uniformly, regardless of whether the user uses water from a public or private utility system, pursuant to a consumptive use permit issued under Chapter 40E-2, or from a private well for domestic or individual home use.

Resource protection criteria are designed to prevent harm to the resources up to an 1-in-10 drought event. For drought conditions greater than a 1-in-10 event, it may be necessary to decrease water withdrawals to avoid causing significant harm to the resource. Water shortage triggers, or water levels at which phased restrictions will be declared, are used to curtail withdrawals by water use types to avoid water levels declining to a minimum level where significant harm to the resource could potentially occur.

Even though water shortage triggers will be established, a case-by-case analysis for a given drought circumstance will continue to exist. Thus, prior to declaring a water shortage, the District will also analyze the factors listed in the Water Shortage Plan concerning such issues as: (1) whether or not sufficient water will be available to meet the estimated and anticipated user demands; and, (2) whether serious harm to the water resource will occur.

The District expects the water shortage triggers to address resource conditions related to: (1) the surficial aquifer; (2) the District canal system; and, (3) the Floridan aquifer. The resource conditions, which will be used as "triggers", will include saline water intrusion/upconing as well as aquifer impacts.

Saltwater Intrusion. The District will increase regulatory analysis in areas where vulnerability mapping indicates increased potential for saltwater intrusion. Existing and proposed withdrawals should be carefully evaluated by the user and the District during the CUP process with respect to saltwater intrusion, including the use of alternative sources of water. In addition to providing guidance for the CUP process, this information should be used as a planning tool in identifying future withdrawal locations. This analysis is generally consistent with the existing CUP requirements, and will not result in substantive changes to the permitting program.

Wetland Mitigation. The advisory committee discussed the importance and application of mitigation generated by projects in the UEC Region. In particular, the advisory committee wanted to make sure that any mitigation associated with projects in the region stay in the region. For example, if construction/development in the region were to cause impacts to wetlands, the associated mitigation would be used solely in the region. One possible mitigation option is to develop wetland areas in the shallow portions of RAFs or wetland buffers around RAFs, where the opportunity exists. The committee also concluded that incorporation of water supply benefits in mitigation programs should be encouraged, including consideration of ground water recharge in land acquisition, and encouragement of mitigation in areas that incorporate both environmental and water supply (recharge) objectives.

Coordination. The District will continue coordination of the UEC Water Supply Plan with local governments/utilities, the SJRWMD, IRL Restoration Feasibility Study, the C&SF Comprehensive Review Study, and other related efforts to promote compatibility.

Special Designations. Three special designations in the UEC Planning Area contained in the CUP Program were reviewed based on the findings of this planning effort. Definitions of the designations and recommended changes, if any, are provided below.

(a) Reduced Threshold Areas. Reduced threshold areas (RTAs) are areas of the District where the volume of usage delineating a general permit from an individual permit has been reduced from 100,000 gallons per day (GPD) to 10,000 GPD average day demand. RTAs have typically been designated in resource depleted areas where there is an established history of substandard water quality, saline water movement or the lack of water availability to meet the projected needs of a region. Based on the results of the UEC Water Supply Plan, it is recommended that RTA designations (Stuart Peninsula, Lighthouse Point Peninsula, and the Savannas and Jensen Beach Peninsula) in the UEC Planning Area and the RTA concept be eliminated in the UEC Planning Area. The analyses did not indicate significant potential problems in these areas, and assessment determinations are conducted for all consumptive use applications. For withdrawals less than 100,000gpd, qualifying for a general permit versus an individual permit will be based on the potential cumulative impacts of the use.

(b) Water Resource Caution Areas. These areas were formerly referred to as Critical Water Supply Problem Areas and are described in Chapter 40E-23, F.A.C. Water Resource Caution Areas (WRCAs) are defined as areas that have existing water resource problems or areas in which water resource problems are projected to develop over the next 20 years. The entire UEC Planning Area is currently designated as a WRCA. Based on the analysis, it is recommended the designation in the UEC Planning Area be reduced to only incorporate the coastal areas in Martin and St. Lucie counties as indicated in Figure 11. This area generally reflects the service areas of the coastal utilities in the region and areas of planned utility service per local government comprehensive plans. Potential problems are projected in these areas if historically used sources of water are used to meet the growing water needs of the region. The analysis was based on current information and did not include minimum flows and levels.

(c) Restricted Allocation Areas. Restricted allocation areas are District designated areas where the water resources are managed in response to specific surface water and ground water sources for which there is a lack of water availability to meet the needs of the region. The UEC Planning Area contains three restricted allocated areas.

1. Projects located in the Eastern Okeechobee-Northwestern St. Lucie Basin withdrawing water from the Floridan aquifer are limited to 1.5 inches for the maximum month, with the balance of water needs being withdrawn from other sources.

2. Pumps designed to increase the withdrawal rate above that which occurs naturally are prohibited on all Floridan wells located in Martin and St. Lucie counties unless the pump was in place and operational on the well prior to March 2, 1974 or the applicant justifies that the pumping will not have an adverse impact on any existing legal use.

3. No additional water will be allocated from, or direct connections to, the C-23, C-24, or C-25 over and above existing allocations, until District investigations show that additional water is available for allocation.

Based on the analysis, it is recommended the District eliminate the 1.5 inch allocation restriction in northwest St. Lucie County (number 1 above). The modeling did not indicate any potential problems using full supplemental demand during a 1-in-10 drought condition. In addition, the District should continue the practice of prohibiting pumps on Floridan wells (number 2 above) except for short-term usage during extreme water shortages and freezes. Also, based on the surface budget analysis, the District should continue prohibiting new or expanded allocations from the C-23, C-24 or C-25 (number 3 above) until additional surface water is determined to be available through reassessment of the surface availability upon implementation of the IRL Restoration Feasibility Study solutions. The analysis indicated there is not sufficient surface water to support the demand on these canals during a 1-in-10 drought condition.

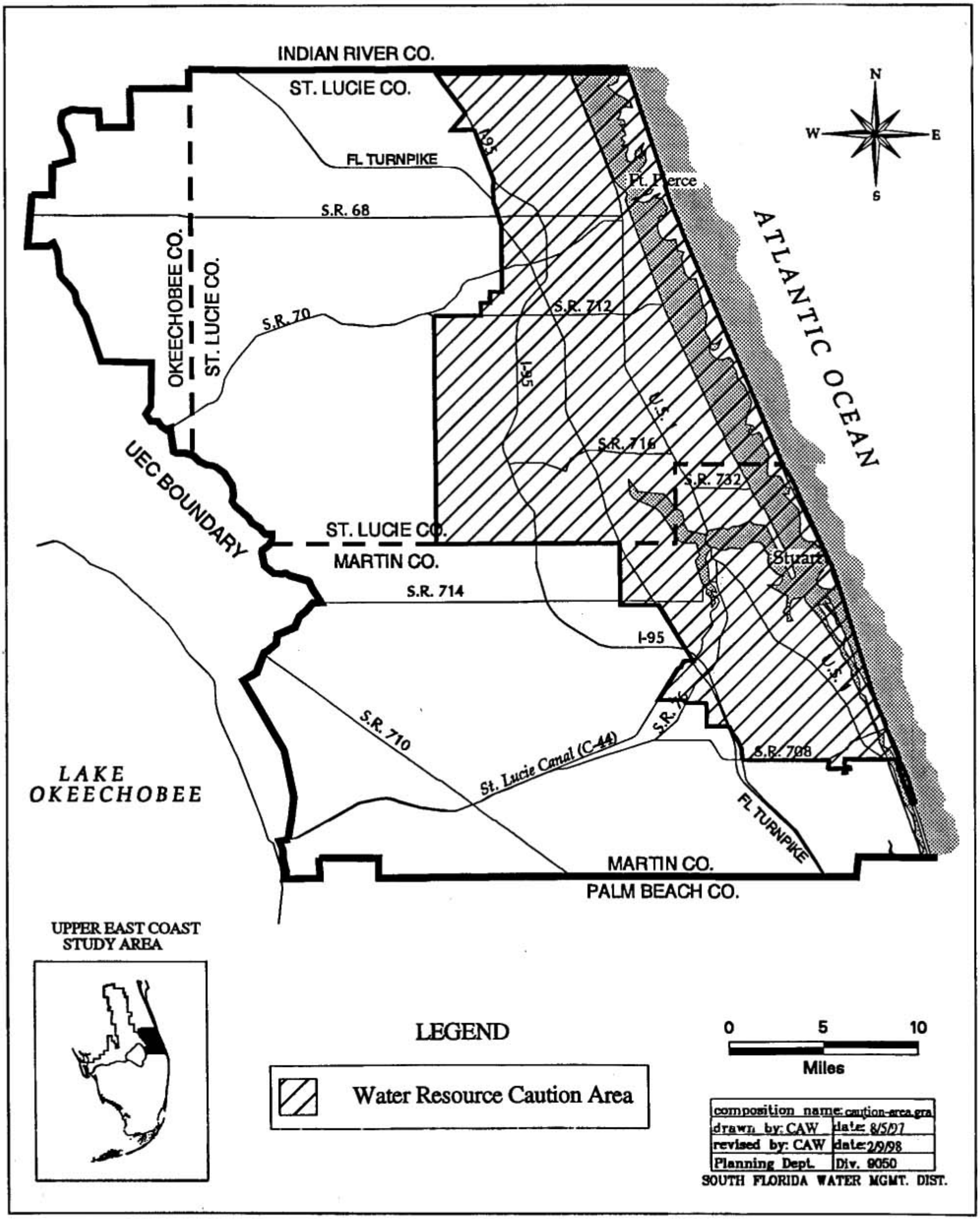

Figure 11. Proposed UEC Planning Area Water Resource Caution Areas (Generalized).

Permit Duration. House Bill 715 amended s.373.236, Duration of Permits. The new statute provides that:

> Permits shall be granted for a period of 20 years, if requested for that period of time, if there is sufficient data to provide reasonable assurance that the conditions for permit issuance will be met for the duration of the permit; otherwise permits may be issued for shorter durations which reflect the period for which such reasonable assurances can be provided.

The advisory committee recommends that requests for 20 year permits be consistent with the UEC Water Supply Plan prior to issuance. The conditions upon which a 20 year permit will be recommended will be defined as part of the rulemaking process.

UECWSP Update. The advisory committee recommends this UECWSP be updated following completion of the Indian River Lagoon Restoration Feasibility Study and the C&SF Comprehensive Review Study (Restudy). The intent of this recommendation is to allow incorporation of the results of those studies into the development of next UECWSP.

MINIMUM FLOWS AND LEVELS FOR PRIORITY WATER BODIES

In addition to water resource and water supply development strategies, Chapter 373, F.S. requires the water management districts (WMDs) to establish minimum flows and levels (MFLs) for priority water bodies within their jurisdictions. Minimum flows represent the limit at which further withdrawals would be significantly harmful to the water resource or ecology of the area. Minimum levels are the level of ground water in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources. The statutes direct WMDs to prepare a priority list and schedule for the development of MFLs in November of every year. The UEC Planning Area contains two priority water bodies, which have been previously identified by the SFWMD: the St. Lucie Estuary (SLE) and the Floridan aquifer. The District Water Management Plan currently contains a year 2000 deadline for both water bodies. The District proposes to delete the Floridan aquifer from the District's 1997 priority list (see Floridan aquifer discussion below) and revise the completion date for the SLE to 2001 to reflect the revised definition for MFL establishment.

St. Lucie Estuary

A description of the St. Lucie Estuary and Indian River Lagoon SWIM Plan is provided in Chapter 2. As the first step in developing a minimum flow for the SLE, District staff updated the inflow/salinity model database, and used a one-dimensional model to generate predictive inflow/salinity curves for the inner and middle estuary. The preferred salinity range for the SLE is based upon the salinity requirements for species of particular importance to the system; in this case primarily oysters, and secondarily seagrasses. This information, in combination with historical oyster distributions, has been compared to the inflow/salinity curves to develop the preliminary “salinity envelope” for the SLE and has been described in the 1994 IRL SWIM Plan. The flow ranges associated with the salinity envelope include the combined flows from each contributing basin and from ground water.

Comparing the estimated mean monthly basin flows to the SLE salinity target indicates that freshwater flows from every basin frequently exceed the desirable range and that minimum base flows are also not sufficiently sustained. The effects of insufficient minimum flows, which translate into increased salinities, are varied according to the timing and duration of the event and the developmental stage of the target organism. High salinities have been documented to interfere with the successful development and settling of veliger larvae of oysters. High salinities also result in physiological stress in adult oysters, and the increased presence of oyster predators and diseases. The effects of high salinities on growth and reproduction of seagrasses are not as well understood.

Maximum flows also have a negative impact on the SLE. The development of the contributing watersheds has significantly increased the quantity and altered the timing of fresh water into the estuary. These changes degrade water quality by affecting the salinites and by increasing the amount of nutrients, suspended solids and toxins which are delivered from the watersheds along with the fresh water. The fresh water itself can directly harm seagrasses and oysters by exposing these sessile organisms to lower salinity levels than they can tolerate. The nutrients often cause algal blooms which result in unhealthy levels of dissolved oxygen and increased water color both of which are detrimental to many estuarine organisms. The suspended solids that are transported from upstream during larger storm events also affect water color and also contain organic material which flocculated out of the water column when the fresh water meets the brackish water. This results in the accumulation of muck deposits. The muck deposits which are found extensively in the SLE degrade oyster habitat and allow for the establishment of pollution tolerant benthic organisms.

The proposed process to define the minimum flow (and maximum flow) for the St. Lucie Estuary is as follows:

1. Develop a defensible definition of significant harm, in terms of minimum and maximum freshwater inflows based upon the harmful effects of alterations to the salinity regime, distribution, timing, duration and water quality, in relation to key estuarine species.
2. Define appropriate salinity range or “envelope” (minimum and maximum) for the St. Lucie Estuary based upon key species or Valued Ecosystem Components as defined by EPA. These species are those determined to be representative of a healthy estuarine ecosystem, and may include oysters, seagrasses, or regionally significant fisheries. This work effort has been accomplished through the IRL SWIM Program, although additional work is
underway to more fully document the historic, current and potential locations of desirable species.
3. Determine required cumulative freshwater inflows to the inner estuary that maintain salinity within appropriate upper limits.

4. Apportion total estuary inflow among respective SLE basins, and determine respective dry season and wet season target volumes from each basin.
5. Identify the source, volume and timing of discharges that violate minimum and maximum flow target levels.
6. Evaluate strategies to manage the timing of discharges to the SLE to appropriate levels.
7. Select and implement watershed management projects to achieve the target minimum and maximum flows.

8. Develop Recovery or Prevention Strategy, as required by Section 373.0421, F.S.

In order to define the minimum and maximum flows at which "significant harm" to the ecosystem will occur, it will be necessary to review the salinity distribution patterns for the estuary and determine the timing, distribution, duration and reoccurrence of very low or no flow conditions. The salinities that result from these events will then need to be compared to published and ongoing experimental studies on the effects of high salinity on oysters and seagrasses. This work is currently underway through a series of contracts and field and laboratory experiments, scheduled for completion in 1998. Once the preliminary minimum flows have been established, the District will initiate rulemaking and public review and comment for the formal establishment of a minimum flow for the Estuary. Establishment of the MFL for SLE is not contingent on SWIM funding.

Floridan Aquifer

The Floridan aquifer was originally listed as a priority for development of MFLs due to concerns about the water quality impacts of sustained substantial withdrawals from this source. During the planning process, a Floridan aquifer subcommittee was established to make recommendations associated with Floridan issues. Based on the subcommittee's recommendation that the current restrictions on the use of pumps for all uses be maintained, the analysis, and the belief on many members' part that use of the Floridan is essentially self-regulating, the advisory committee concluded that the Floridan aquifer no longer should be included on the immediate list for development of MFLs. The need to include the Floridan aquifer on future MFL priority lists will be reassessed during future updates to this plan.

CONCLUSIONS

The results of this regional analysis indicate that historically used sources of water, primarily the SAS in the urban coastal areas, are not adequate to meet the growing needs of the UEC Planning Area during a 1-in-10 drought condition. Potential impacts on wetlands, as well as the potential for saltwater intrusion, increase using estimated future demand levels. In addition, potential impacts were also simulated in some areas using 1990 water demand levels during a 1-in-10 drought condition. However, with diversification of supply sources (e.g., Floridan aquifer, wastewater reuse), the analysis indicated the existing and future water demands can be met with minimal potential impacts.

The results of the surface water budget analysis verify that the surface water availability during a 1-in-10 drought condition under the existing canal and storage network, is not adequate to support the water supply demands on them. However, supplementing these surface water supplies with ground water sources, primarily the Floridan aquifer, was shown to be sufficient to meet the existing as well as future demands. There is a concern for water quality in the Floridan aquifer, and the long-term sustainability of the Floridan aquifer as source of water for irrigation of citrus. Development of alternate water source options and water conservation should be encouraged to conserve the Floridan aquifer in the agricultural areas. However, based on limited historic water quality information and projected water levels, significant changes in water quality are not anticipated. A comprehensive Floridan aquifer monitoring network should be established to collect the data necessary to establish the relationship between water use, water levels, and water quality.

At this time, the resource protection criteria used in this plan appear to be adequate for protecting the resources. However, existing and proposed data collection efforts and studies, such as the District's wetland study and Floridan aquifer monitoring network, should be conducted to refine the criteria.

The advisory committee agreed that freshwater discharges (minimums and maximums) are affecting the health of the St. Lucie Estuary and the Indian River Lagoon, as well as losing this water from the water supply inventory. The advisory committee recommends the IRL Feasibility Study be completed and implemented to address freshwater discharges to the St. Lucie Estuary and increase surface water availability for water use; and the Ten Mile Creek project and associated funding as well as similar projects, be pursued.

The committee concluded the primary purpose of the Feasibility Study should be environmental restoration. Evaluations of increasing surface water availability for water supply purposes should strive for providing a 1-in-10 level of certainty from surface water as an optimal goal. However, it is recognized this may not be cost-effective.

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